Esophageal Manometry in Gastroesophageal Reflux Disease

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KEYWORDS

- High-resolution manometry • Esophageal hypomotility
- Hypotensive lower esophageal sphincter • Preoperative testing
- Multiple rapid swallows

KEY POINTS

- High-resolution manometry (HRM) is an effective tool to study pathophysiologic motor events in gastroesophageal reflux disease (GERD).
- HRM has clinical utility in excluding esophageal outflow obstruction mimicking GERD.
- Preoperative esophageal HRM can alter surgical decisions and is of clinical value before antireflux surgery.
- Provocative testing during HRM may assess esophageal smooth muscle peristaltic reserve.

INTRODUCTION

High-resolution manometry (HRM) marks a major advance in the clinical evaluation of esophageal motor disorders. HRM topographic contour plots, known as Clouse plots, are more intuitive than conventional manometry waveform recordings, allowing for pattern recognition and utilization of software tools for interrogation, thereby reducing interobserver variance in interpretation.[1,2] This article discusses the use of HRM in evaluating patients with GERD symptoms in terms of both manometric correlates of GERD and motor findings useful in preoperative assessment for antireflux surgery.

ADVANCES IN ESOPHAGEAL MANOMETRY

Manometry systems are designed to measure the timing and amplitude of pressure events in the esophagus and its sphincters via a linear array of pressure sensors on a catheter. Assimilation, integration, and display systems convert these pressure recordings into electrical signals that can be displayed as pressure waveforms or topographic pressure plots. The roots of HRM began in the mid-1970s when the first

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high-fidelity manometry system was developed by Jerry Dodds and Ron Arndorfer.[3] This initial system was composed of water-perfused catheters, a pneumohydraulic pump, pressure transducers, and a strip-chart recorder with side holes spaced at 3- to 5-cm intervals. The apparatus was later modified by replacement of the strip-chart recordings with digital-analog converters and a video display on computer screens. Manometry subsequently evolved to the use of solid-state catheters, allowing for circumferential pressure averaging and finer evaluation of the pharynx and upper esophageal sphincter (UES) because of a faster frequency response that was better at sensing striated muscle contraction.[4] Critical to the evaluation of the esophagogastric junction (EGJ), a 6-cm perfused sensor called the Dent sleeve was developed in 1976, which increased the ability of the manometry catheter to remain within the LES during esophageal movement,[5] thereby increasing accuracy in LES assessment.

A major step forward occurred in the 1990s when Ray E. Clouse envisioned and developed HRM.[6] This advance involved a vast increase in sensors on the esophageal manometry catheter, generating pressure data that could be displayed as a spatiotemporal plot using color contours to designate pressures (**Fig. 1**). Modern HRM systems use circumferential solid-state sensors 1 cm apart, as well as custom assimilation and display software that allows intuitive interpretation using software tools. Because pressure phenomena from the entire esophagus can be visualized at once, sphincters can be easily identified, thus rendering the stationary pull-through maneuver obsolete.[6] Identification of LES relaxation errors improved, and achalasia is now diagnosed with better accuracy.[4] The technique also provided new insights into gastroesophageal reflux disease (GERD) by refining manometric correlates for the condition, both static (LES basal pressures, hiatus hernia) and dynamic (esophageal peristaltic performance), thereby serving as a useful tool in preoperative evaluation before antireflux surgery.[7] In recent years, the Chicago Classification created new standards by which researchers and clinicians analyze Clouse plots to better describe esophageal motor phenomena.[8] However, the Chicago Classification remains fluid and evolving, and new parameters continue to be designed that better evaluate pressure phenomena in the context of GERD.

PATHOPHYSIOLOGIC CORRELATES OF GERD ON HRM

By the Montreal definition, GERD develops when the reflux of stomach contents causes troublesome symptoms and/or complications.[9] The disease is common worldwide and reduces the quality of life.[10] Proton-pump inhibitors (PPIs) are the mainstay of GERD management, working by binding to the H^+,K^+-ATPase enzyme in the gastric parietal cell to decrease the production of gastric acid. Although this medication class is excellent at suppressing acid production, 30% to 40% of GERD patients continue to have symptoms because the medication does not reverse the pathophysiology of GERD,[11,12] since transient lower esophageal sphincter relaxations (TLESRs), thought to be the critical motor event leading to GERD, are not affected by PPIs. Though physiologically useful in allowing uncomfortable gas release from the stomach, TLESRs are pathologic when gastric contents escape into the lower esophagus, leading to symptoms and mucosal injury.

Transient Lower Esophageal Sphincter Relaxations

Early manometric studies demonstrated a higher proportion of TLESRs accompanied by acid reflux in GERD patients in comparison with controls. Holloway and colleagues[13,14] defined objective conventional manometric criteria for detecting TLESRs,